

**Example of application of emissions results to fleet  
for heavy-duty highway diesel engines**

Engine Group	Engines required	Estimate of contribution to fleet
Light-heavy duty	1	15%
Medium-heavy duty	2	20%
Heavy-heavy duty	2	35%
EGR-equipped	2	30%

Engine Group	Engines tested	% change w.r.t. base fuel (parentheses not significant)			
		NO <sub>x</sub>	PM	HC	CO
Light-heavy duty	0	0	0	+5	0
Medium-heavy duty	2	-6	(-2)	(+11)	(+2)
Heavy-heavy duty	2	-4	-6	+5	(-3)
EGR-equipped	0	0	0	+5	0
Fleet-wide verification		- 2.6	- 2.1	+6.2	+0.4

$$\begin{aligned}\text{Fleet NO}_x &= 15\% \times 0 \\ &+ 20\% \times -6 \\ &+ 35\% \times -4 \\ &+ 30\% \times 0 \\ &= - 2.6\end{aligned}$$

$$\begin{aligned}\text{Fleet PM} &= 15\% \times 0 \\ &+ 20\% \times 0 \\ &+ 35\% \times -6 \\ &+ 30\% \times 0 \\ &= - 2.1\end{aligned}$$

$$\begin{aligned}\text{Fleet HC} &= 15\% \times 5 \\ &+ 20\% \times 11 \\ &+ 35\% \times 5 \\ &+ 30\% \times 5 \\ &= + 6.2\end{aligned}$$

$$\begin{aligned}\text{Fleet CO} &= 15\% \times 0 \\ &+ 20\% \times 2 \\ &+ 35\% \times 0 \\ &+ 30\% \times 0 \\ &= + 0.4\end{aligned}$$

## Adjustment for alternative base fuel

-6.2% = Change in NO<sub>x</sub> for California diesel with respect to nationwide average fuel

X = Change in NO<sub>x</sub> for candidate fuel with respect to nationwide average fuel

% change in NO<sub>x</sub> for candidate fuel with respect to California diesel =  $(X + 6.2) / (1 - 6.2/100)$

Table III.F-2 of EPA Staff Discussion Document

NO <sub>x</sub>	- 6.2 %
PM	- 8.5 %
HC	- 19.4 %

## Calculation of emission impacts for cumulative effects

$$\begin{aligned} \ln(\text{NO}_x) = & \quad a_1 \times \text{VEH1} \\ & + a_2 \times \text{VEH2} \\ & + \text{etc.} \\ & \\ & + b_1 \times \text{VEH1} \times \text{mileage} \\ & + b_2 \times \text{VEH2} \times \text{mileage} \\ & + \text{etc.} \\ & \\ & + c \times \text{CANDIDATE} \end{aligned}$$

If coefficient  $c$  is statistically significant, then

$$\begin{array}{l} \% \text{ change in fleet-wide} \\ \text{NO}_x \text{ emissions} \end{array} = [\exp(c) - 1] \times 100\%$$